Climate change, wheat yield and cropping risks in Western Australia

July 2003 – June 2007

Location: Western Australia

Principal investigator

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The need

Climate change is an important issue for the longer-term development of the grains industry. Changes in the frequency of weather events and extremes are likely to occur as global warming progresses.

The grains industry is a significant part of the Western Australia (WA) state economy. There are limited viable land use alternatives at present. Rainfed agriculture is likely to remain a feature of broadscale enterprises over most of the agricultural region. And in the future, as now, climate will be a major determinant of productivity and quality. The nature and stability of future climate will therefore have significant implications for the grains industry over the long term.

Recent government and community interest in long-term land use and industry planning in WA has shown the existing, and probably increasing, demand for information on future climate in agricultural areas.

How this project fits with MCV objectives

This project investigates the effects and risks of changing climate variability over time. A major benefit to the grains industry is that a clearer picture of future climate risks can be obtained. Long-term industry planning will have access to better information on future climate-related risks and opportunities.

Project objectives

1. Test how well the downscaled global climate model data fit with observations
2. Apply the downscaled daily weather data to the APSIM-wheat crop model
3. Investigate changes in wheat yield, quality and development between current climate and plausible future climate in WA
4. Investigate changes in climate risks such as frost incidence or heat stress

Project: DAW00088
Product code: PF061111

March 2006

Methods

This study uses simulations of global climate from the CSIRO Mk 3 and other international models for present day and projected future conditions. Statistical downscaling techniques developed by CSIRO Land and Water generate files of daily weather variables for selected locations in the cropping region of Western Australia.

The daily climate files are for current conditions (daily weather and CO_2 concentration), and for climate of the middle of the 21st century (with enhanced CO_2). These form the basis for climate change impact studies using the APSIM-wheat simulation model. Changes in crop production or quality from current to future climate will be investigated at individual locations. Seasonal risk statistics such as the timing and occurrence of frost events will also be derived from daily temperature extremes.

Desired outcomes

A clearer understanding of climate change projections and impacts on wheat production and quality at a regional level in WA. This will (hopefully) lead to better-informed planning and adaptation of the grains industry to climate change.

Achievements to date

We have assembled all the climate datasets from the global climate models, tested them against observations and run them on APSIM-wheat for three locations in the WA grain belt. The results so far indicate that the response of crop yield to future climate varies according to location.

Growing season rainfall decreased at all three sites for future climate. Mean wheat yields increased at the wettest site, but decreased at the driest site. Enhanced CO_2 appeared to provide a benefit but it was not enough to compensate for reduced rainfall in the eastern wheat belt.

The methodology of using downscaled daily climate data from global climate models appears to be reliable for southern WA. The simulation of temperature is good, but rainfall is less well simulated. The downscaling model reproduces observed rainfall patterns, but the global climate models do have some biases in rainfall.

Although this project is not specifically aimed at the individual farmer, it has the scope to better define changes in cropping and climate risks for the future.

What is left to do?

- Options for adaptation with respect to tactical decision-making; this will be informed by MCV projects that define key farming decisions
- Better integration of the yield outcomes in this project, with studies looking at climate change and farming system and economics

MCV is a collaborative program between the Grains, Rural Industries and Sugar Research and Development Corporations; the Australian Government Natural Heritage Trust and Department of Agriculture, Fisheries and Forestry; Dairy Australia; Meat & Livestock Australia; and Land & Water Australia. The National Farmers Federation and Australian Wool Innovation Limited are associate partners.

For more information on MCV, visit http://www.managingclimate.gov.au
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